ECHINODERMA.

By W. B. Benham, D.Sc., F.R.S., University of Otago.

Plates VII–XI.*

Mr. Waite was good enough to place the echinoderms in my hands for identification, which at first seemed likely to be no serious task, for this Museum has a good collection of native representatives of the group, while the useful lists and notes and descriptive papers by Mr. Farquharson served to simplify the task.

One of the first species that I happened to examine was the so-called *Salmacis globator*, in reality an *Echinus*, an account of which I have recently published. The discovery that this little *Echinus* had for nearly thirty years been masquerading under a name to which it had no shadow of right put me on my guard as to the possibilities of other errors having crept into identifications made in early days of zoological research in New Zealand. Again, I soon found that the generic names of some of our best-known starfishes have in recent years received new interpretations, necessitating the removal of the species to other genera, and that old genera have been broken up as an outcome of new knowledge.

I was thus soon involved in the tedious task of searching the "Zoological Record" for the last twenty years—that is, the period that has elapsed since the publication of the report of the "Challenger"—and during this period several important expeditions have been undertaken by American and European scientific men to all parts of the ocean, which has resulted in a great accession of new material, and has led to repeated revision of the work of earlier naturalists.

Unfortunately, the reports of these expeditions are not available in the libraries in New Zealand, hence I have had to rely on the meagre information contained in such text-books as Bronn's "Thier-reichs," the "Zoological Record," and a few memoirs to which I happen to have access; so that, under the circumstances, it is quite possible that I have fallen into new errors. For example, relying on the "Thier-reichs" and on Yves-Delages' "Zoologie Concrete" as being trustworthy guides in systematic work, I placed *Echinus albocinctus* in Mortensen's genus *Pseudechinus;* but I have since become aware that his method of work, and the grounds for the rearrangement of the genera, are considered by such authorities as Agassiz and Loriol as injudicious and unscientific. The task of the systematist in a land without modern books or scientific periodicals is a difficult one, but the work has to be done; we have to do our best, and offer our apologies if inaccuracies creep in.

---

* For explanation of plates see p. 115.

I have to thank Mr. Farquharson for much help and advice contained in letters in reply to my queries, and for the loan of foreign memoirs.

Although the collection is not very extensive, it adds a few genera to our list, and some species new to science.

A total of twenty-six genera and thirty-one species is recorded.

Of thirteen species of asterids, belonging to ten genera, there are three genera which have not hitherto been recorded from our area—viz., *Odontaster*, *Mediaster*, and *Luidia*.

Of ophiurids there are six genera, each represented by one species; of which one genus (*Astrotoma*) has not previously been obtained from so southern a latitude.

The echinids are represented by seven species, belonging to five genera, of which one genus (*Porocidaris*) is new to the New Zealand fauna.

Of the five species of holothurians, representing as many genera, one species of *Molpadia* appears to be new to science.

Amongst the most interesting finds is *Odontaster grayi*, hitherto recorded only from the neighbourhood of Tierra del Fuego—another instance of the subantarctic nature of much of our marine fauna.

The occurrence of a species of *Mediaster*, closely allied to but not identical with *M. arcuatus*, from the Japanese seas, adds another link with the fauna of that region of the Pacific, which is illustrated by the gephyrean *Echiurus novæ-zealandiæ*, by the hemichordate *Dolichoglossus otagoensis*, and by certain annelids. But species of the genus *Mediaster* also occur in the eastern Pacific off the west coast of the American continent, from Vera Cruz, Cocos Island, and Acapulco. The occurrence, then, of a species in the western Pacific marks an important extension of the range of the genus.

Astrotoma waitei is another interesting connection between the species found in the Banda Sea and Sulu Archipelago on the one hand, and that found in the Strait of Magellan on the other; while the presence of *Porocidaris elegans*, hitherto recorded from the neighbourhood of Sydney and the Philippines, represents still another element in our fauna—the tropical one.

Of the holothurians, two deep-water forms occur, of which *Molpadia marenzelleri* had hitherto only been obtained by the "Challenger" from our seas.

Some confusion in the records resulted from accidents happening on board the trawler, during heavy weather, as explained by Mr. Waite in the "Introduction."

LIST OF SPECIES OBTAINED.

Class ASTEROIDEA.

Order PHANEROZONIA.

Family Astropectinidæ.

Psilaster, Sladen, 1885.

P. acuminatus Sladen.

Luidia, Forbes, 1839.

L., sp. incert.

Family Archasteridæ.*

Odontaster, Verrill, 1880.

O. grayi Bell.

Asterodon, Perrier, 1891.

A. miliaris Gray.

Family Pentagonasteridæ.

Pentagonaster, Gray, 1840.

P. pulchellus Gray.
P. abnormalis Gray.

Mediaster, Stimpson, 1862.

M. sladeni sp. nov.

Family Asterinidæ.

Asterina, Nardo, 1834.

A. regularis Verrill.

Order CRYPTOZONIA.

Family Stichasteridæ.

Stichaster, Muller and Troschel, 1840.

S. polyplax Muller and Troschel.
S. insignis Farquhar.

Family Echinasteridæ.

Echinaster, Muller and Troschel, 1840.

E. farquhari sp. nov.

---

* I have followed Bell, Hamann, Delages, in placing these two genera in this family instead of in the next.

Family Asteridæ.

Asterias, Linnæus, 1766.

A. calamaria Gray.
A. mollis Hutton.

Class OPHIUROIDEA.

Order STREPTOPHIURIDA.

Family Ophiomxyidæ.

Ophiomyxa, Muller and Troschel, 1842.

O. australis Lutken.

Order CLADOPHIURIDA.

Family Astronycidæ.

Astrotoma, Lyman, 1875.

A. waitei sp. nov.

Order ZYGOPHIURIDA.

Family Amphiuridæ.

Amphiura, Forbes, 1842.

A. noræ sp. nov.

Ophionereis, Lutken, 1859.

O. schayeri Muller and Troschel.

Ophiactis, Lutken, 1856.

O. nomentis Farquhar.

Family Ophiodermatidæ.

Pectinura, Forbes, 1842.

P. maculata Verrill.

Class ECHINOIDEA.

Sub-class REGULARIA.

Order CIDARIDA.

Family Cidaridæ.

Goniocidaris, Desor, 1846.

G. umbraculum Hutton.

Porocidaris, Desor, 1854.

P. elegans Agassiz.

Order DIADEMOIDA.

Family ECHINIDÆ.

Echinus, Linnæus, 1758.

E. angulosus (?) Leske.
E. albocinctus Hutton.
E. huttoni Benham.

Sub-class IRREGULARIA.

Order CLYPEASTRIDA.

Family CLYPEASTRIDÆ.

Arachnoides, Agassiz, 1841.

A. placenta Linnæus.

Order SPATANGIDA.

Family SPATANGIDÆ.

Echinocardium, Gray, 1845.

E. australe Gray.

Class HOLOTHUROIDEA.

Order ACTINOPODA.

Family CUCUMARIDÆ.

Phyllophorus, Grube, 1840.

P. longidentis Hutton.

Family MOLPADIDÆ.

Caudina, Stimpson, 1853.

C. chilensis J. Müller.

Molpadia, Cuvier, 1817.

M. marenzelleri Theel.
M. dendyi sp. nov.

Order PARACTINOPODA.

Family SYNAPTIDÆ.

Chirodota, Eschscholtz, 1829.

C. gigas Dendy.

DESCRIPTION OF THE SPECIES.

Psilaster acuminatus Sladen.*

Psilaster acuminatus Sladen, "Challenger" Report, Asteroidea, xxx, 1889, p. 225.

Station 7.

Four specimens were obtained, the largest of which measures R. = 70 mm., r. = 15 mm., breadth of arm at base 16 mm. The ratio of r. to R. is rather less than 1 to 4·6. The colour of the dried specimens is pinkish-brown on the upper surface. Of these four, one was obtained off the south coast of the South Island, at a depth of 43 fathoms; the three others had no number attached, but were no doubt obtained off the east coast of the South Island.

[In addition, I have a specimen in the Otago University Museum which shows the characteristic adpressed inframarginal spines better than the above, for it is uninjured.]

Localities.—South of South Island [also (O.U.M.) west coast of North Island: and ("Challenger"), near western entrance to Cook Strait].*

Luidia, sp.

Plate X, figs. 4, 5.

Station 89.

Two arms, or portions of arms, were amongst the material dredged off Cape Runaway, on the east coast of the North Island, from a depth of 66–94 fathoms. The long, slender, tapering form of the arms recalls the figure of *L. africana* Sladen [35, p. 256],† which, however, comes from the Atlantic. I refrain from giving a name to these fragments, but will put on record the description, which may lead to the identification of the species by others who have access to more literature than is available here.

The arm is 35 mm. in length and 6 mm. across the broader end, tapering to a point.

The abactinal surface is densely covered with small paxilli consisting of rough, thorny spines; each plate bears a central rather larger one surrounded by a circle of nearly horizontally disposed spines.

---

* I enclose in square brackets New Zealand localities in addition to those at which they were obtained during this expedition. "O.U.M." means that a specimen is in the Otago University Museum, and "F." that Mr. Farquhar has recorded it.

† The figures within square brackets refer to the bibliography at the end of the paper.

The margin of the arm presents only a single row of marginals (identified as inframarginal in this genus); each bears two spines, long and white, which are differently arranged on alternate plates. One series of plates bears a spine close to the upper (abactinal) margin, and a second one of nearly the same length about half-way down the lateral face; on the alternate plates, however, the upper spine arises at a spot about one-quarter of the height of the plate, and the second, which is shorter, near the lower (actinal) margin. So that, looked at lengthwise, the arm has four rows of spines; they are fine-pointed, circular in section, the upper ones being slightly larger than the other, and measure 4 mm.—*i.e.*, they are nearly as long as the width of the arm. The species appears to be characterized by this alternate arrangement of the spines.

In addition, the marginals bear numerous very short delicate spinules in two vertical rows before and behind the large spines: they are covered by a pale reddish-brown skin. I see no pedicellariæ. The adambulacrals carry two spines: one short, geniculate, springs from within the groove, and a larger one from the actinal surface, about 2 mm. in length, or half that of the marginal spines. From around its base spring a few short spines as on the marginals. There is thus a resemblance to *L. longispina* Sladen (p. 254).

Odontaster grayi Bell.

Calliderma grayi Bell, P.Z.S., 1881, p. 95.

Gnasthaster grayi Sladen, "Challenger" Report, xxx, 1889, p. 750.

Odontaster grayi Bell, P.Z.S., 1893, p. 261; Ludwig, Zeit. f. Wiss. Zool., lxxxii, 1905, p. 44.

A single individual was obtained. Unfortunately, no station-number was attached when it reached me, but I suspect it was obtained off the coast of Otago. The colour is uniform pale-brown. In size it is just double that described by Bell in 1881, having R. 30, r. 16; and the ratio is therefore—r. : R. = 1 : 1·87.

In form it is more distinctly a five-rayed star than Bell's figure, and resembles Ludwig's figure of *O. penicillatus* [29, pl. v, fig. 4]; but in the two specific characters on which Ludwig lays stress—viz., (1) the proportion of R. to r., and (2) the number of marginals—my specimen agrees with *O. grayi*. There are ten supramarginals on each side of the arm, the terminals being quite small; so that, with the interbrachial, there are twenty-one from tip to tip of the neighbouring arms. Most of the granules on these plates have been rubbed off, so the condition of those along the contiguous edges of the plates is not satisfactorily determinable; but the few that remain allow one to recognise that the suture would be readily seen—a feature which, according to Ludwig, is more or less characteristic of *O. penicillatus*, though he lays less stress on this character than on the two referred to above.

The abactinal plates on the arms exhibit a differentiation into median slightly larger plates, and lateral or intermediate plates. The abactinals cease at the level of the last three or four marginals, so that these are in contact across the arm (which, Ludwig states, is never the case in *O. penicillatus*).

I have in the Otago Museum a specimen which was obtained in 1900, which in form is more nearly pentagonal than that represented in Bell's figure, and more like Ludwig's figure (pl. v, fig. 6). In it the marginals are in a better state of preservation than in the "Nora Niven" specimen, and the marginal tubercles have distinctly this *penicillatus* arrangement—*i.e.*, a smooth groove is visible between contiguous marginals: the tubercles do not interdigitate over this groove. The abactinal plates are continued, in three arms, to the apex; in the other two arms the last pair of marginals meet dorsally.

The measurements in this specimen are R. 33, r. 21; and r. : R. = 1 : 1·57. The last feature is characteristic of *O. grayi*, and the existence of only eight marginals on each side is confirmatory, though the other two characters might point to *penicillatus*.

Locality.—[East of Otago Heads, 20–40 fathoms (O.U.M.).]

Remarks.—This little starfish is readily distinguished from *Asterodon miliaris*, apart from its smaller size, by the distinctly spinous character of the plates, and by the single glassy-tipped dental spine at each angle of the mouth.

The occurrence of this species in our waters is an extremely interesting geographical fact, as hitherto it has only been found in the Magellan Straits, off Tierra del Fuego, and at the Falkland Islands, in a depth of from 10 to 105 fathoms.

Asterodon miliaris, Gray.

Astrogonium rugosum Hutton, 1872.

Gnathaster miliaris Farquhar, Trans. N.Z. Inst., xxxix, 1906, p. 126.

In this paper Farquhar gives the earlier synonymy.

Stations 15, 16, 22, 26, 29.

I had, independently of Mr. Farquhar, arrived at the conclusion that Hutton's *A. rugosum* is identical with Gray's species, as a result of an examination of the type in the Dominion Museum, which Mr. Hamilton, the Director, was good enough to lend me for the purpose in March, 1907.

In placing it in the Archasteridæ instead of the Pentagonasteridæ I follow Bell, Bronn, Delage, and others. In deciding on its title to be placed in the genus *Asterodon* I am influenced by the following considerations: This family contains several sub-families, of which the Gnathasterinæ consist of starfishes with well-developed oral angles, which may bear one or two dental spines, glassy-tipped and aborally directed. There are, according to Delage, five genera: *Asterodon*, Perrier; *Odontaster*, Verrill; *Acodontaster*, Verrill; *Goniodon*, Perrier;

and *Hoplaster*, Perrier. The last may be omitted from the discussion; and both Bell [6] and Ludwig [29] regard *Acodontaster* as having no generic value. It is with some diffidence that I place our species in Perrier's genus *Asterodon*, for I have only Hamann's brief diagnosis [21] and Ludwig's figure of *Asterodon singularis* to enable me to arrive at this conclusion. Bell [6] quotes from Perrier's (1891) diagnosis of *Asterodon*, from which it appears that some species may have one dental spine on each angle, and some species two such spines; and he regards *Odontaster*, *Gnathaster*, and *Asterodon* as synonymous, the former having priority of nine years. But in 1894 Perrier established the genus *Goniodon* for the New Zealand *G. dilatatus*, which appears from the diagnosis in Bronn, &c., to differ from *Asterodon* and *Odontaster* only in the great dilatation of the marginals before their sudden decrease in size at the tip of the arm; but, as Loriol showed (1895), there are two dental spines at each oral angle. Ludwig (1905, p. 42) uses *Odontaster* for all those forms which possess only a single dental spine, and thus includes Verrill's *Acodontaster* and Sladen's *Gnathaster* as synonymous. In the same memoir Ludwig gives an excellent photogravure of the lower surface of *Asterodon singularis*, from which it appears that this genus has two dental spines: our species has these two spines, as Farquhar noted in 1897. Hence we may, as it appears, place our *miliaris* either in *Asterodon* or *Goniodon*;* but in order to include it in the latter genus it would be necessary to emend the diagnosis: I therefore prefer to adopt the other alternative. And, so far as I can judge, *Goniodon* is not worthy of generic distinction from *Asterodon*; but into that matter I am insufficiently equipped to enter.

Although *Asterodon miliaris* is quite abundant off our coasts, yet it has never received an adequate description, and the difficulty of placing it has arisen from the fact that Gray's type is so badly damaged in the neighbourhood of the mouth that Bell (1893, p. 262) was unable to ascertain whether it is armed with five or ten dental spines. I have sent specimens to the British Museum, so that we may look forward to an authoritative pronouncement as to its generic position in the near future.

General Description.

The general shape is known from Gray's figure. Form, a 5-rayed star, with large disc, short arms, and rounded concave interbrachial areas. The colour is a yellowish-brown. The abactinal plates have rounded platforms covered with small, short, rounded tubercles; the plates are slightly separated from one another by papular areas. Those plates along the median line of the rays are slightly larger than the rest, though this difference is more marked in some specimens than in others. This median row extends to the tip, and is separated from the supramarginals, except the last three or four, by intermediate plates, of which there are at the base of the arms 4 or 5 longitudinal rows, or, in large specimens, even 6 or 7 such plates. The madreporite, which varies in size and shape, is situated about ⅓ r. from the centre. The marginals are covered with small, short, rounded tubercles similar to those on the abactinal plates.

---

* W. K. Fisher, in Anat. Anz., 1908, p. 358, states that "*Goniodon* is invalidated by its earlier use for a mollusc"; and proposes *Diplodontias*, with *D. dilatatus* as type.

In each interbrachial area is an unpaired marginal plate, rather larger, as seen from above, than its immediate neighbours.

The marginals are approximately of equal size throughout the length of the row, but very gradually decrease towards the tip. The number of supramarginals varies with the size; the inframarginals agree in number with them. In the largest (R. = 76) there are 32 marginals from the tip of one arm to the tip of the next. In the smallest specimen measured (R. = 58) there are 24.

The actinal plates are in contact, there being no papulæ; they are more or less polygonal in outline, and bear tubercles of the same character as the abactinals. The number of plates in the interbrachial area varies with the size from 7 to 10 between the oral angle-piece and the inframarginal.

The adambulacrals carry 6 spines in 3 pairs (sometimes a fourth pair is present near the mouth): these are stout, cylindrical, or somewhat prismatic, with rounded ends; the innermost are the largest, and arch over the groove like the rafters of a roof; the outermost are shortest. These last are longer than the tubercles of the disc, and so stand up above the general level of the lower surface.

The oral angle bears a couple of long, cylindrical, glassy-tipped dental spines, directed aborally, and in all the specimens lie prone on the parent plate (see Farquhar, 1897, pl. xiv, fig. 6).

Localities.—Off the east coast of the South Island, between Otago Heads and Oamaru; depths, from 18–44 fathoms. It is confined to New Zealand, and apparently to the east coast and Cook Strait. [Farquhar has also noted it from Tasman Bay, Hawke's Bay, Cape Farewell; and specimens from Stewart Island are in the O.U. Museum.]

Variability.

It is somewhat variable in shape, owing to the greater or less amount of interbrachial excavation, so that the relative diameter of ray and disc varies; some individuals, also, are much flatter than others. The variations affect the following structures:—

(*a.*) The proportion of R. to r. (*i.e.*, of the length of the arm or ray to the length of the interbrachial region of the disc) is ± 2 : 1. In dried specimens it is usually less than 2; in alcoholic specimens more than 2. In a series of five dried ones the lowest proportion is R. : r. = 1·7 : 1, and the highest is 2·06 : 1. In alcoholic specimens, of which four were measured, the lowest is R. : r. = 2 : 1, and the highest is 2·29 : 1. This comparison also indicates that, in drying, the arms shrink more than do the interbrachial areas, which is the reverse of what one would expect. The absolute diameters in millimeters range from R. 58, r. 30, to R. 72, r. 37, dry; and, in alcohol, R. 66, r. 33, to R. 76, r. 34. This variation results in slight differences in outline, the arms being longer or shorter, and the interbrachial less or more excavated.

(*b.*) The arms are sometimes narrow at the base, sometimes broader; in some cases more pointed, in others more rounded at the apex.

(*c.*) The number of supramarginal plates increases with the size: in the smallest (R. = 58) there are 10 supramarginals on each side of an arm, omitting the odd interbrachial plate; the highest number is 16, in a specimen in which R. = 76 mm.

(*d.*) The madreporite is in some but little larger than a neighbouring abactinal plate; in other cases, more than twice the size: it may be circular, or irregularly pentagonal. In the largest individual it measures 10 mm. in diameter.

Pentagonaster pulchellus Gray.

Astrogonium pulchellum Sladen, 1889. Farquhar, Proc. Linn. Soc. N.S.W., xxiii, 1898, p. 310.*

Station 29.

A single specimen was obtained off Oamaru.

R. 40, r. 25 (which is smaller than some other specimens in this Museum, one of which has R. 50, r. 30).

It has the swollen marginals at the ends of the arms, typical of the species, the tip of the arm measuring 15 mm. across.

The abactinal plates are flat, except along the middle of each arm, where each is slightly convex.

Although this species has usually been referred to the genus *Astrogonium* Müller and Troschel (1842), yet, as Verrill (1899) pointed out, Gray (1840) had already placed the species in the genus *Pentagonaster*, of which it stands as the geno-type.

This species is described and figured by Gray [20, p. 11, pl. viii, fig. 3.]

Localities.—Off Oamaru, at a depth of 25–30 fathoms, shell gravel. [Foveaux Strait, Cook Strait, Chatham Islands (F.).]

Pentagonaster abnormalis Gray.

Astrogonium abnormale, auct. Farquhar, *loc. cit.*, 1898, p. 310, for synonymy.

Plate VIII, fig. 5.

Stations 15, 16, 22.

This is a common species off the east coast of Otago, for, in addition to the ten specimens obtained by the "Nora Niven" between Otago

---

* Instead of repeating under each species its full synonymy and references it will suffice to refer to this paper of Mr. Farquhar's.

Heads and Oamaru, at depths of 18 to 44 fathoms, a considerable number were obtained by me in 1899 during trips in s.s. "Doto" and "Plucky" in the same locality. [Also, Nelson, Wellington (F.); Pegasus Bay, and Stewart Island (O.U.M.).]

It was first recorded from New Zealand by Hutton (1872), who refers to a form in the Dominion Museum, Wellington, which differs from *P. pulchellus* in having the apical plates of the arm "very little swollen." He called it "var. B." Farquhar (1895, p. 200) refers to the same specimen, and gives a description of another one obtained by a fisherman at the Bluff. In 1897 he suggested (p. 195) the possibility that this "var. B." is the "*Astrogonium abnormale*" described and figured by Gray [20, pl. viii, figs. 1, 2], the locality of which was unknown. Farquhar [16], in his List of New Zealand Echinoderms, definitely identifies it with Gray's species.

The species presents a good deal of variation, which affects (*a*) the number of supramarginal plates, (*b*) the character of the abactinal plates, which are sometimes quite flat, at other times distinctly convex and even mammilliform, especially along the median line of the rays; (*c*) but the most interesting variation is that which is presented by the supramarginal plates at the apex of the arm, for in some instances these are sufficiently enlarged as to approach the condition which characterizes *P. pulchellus*, and which alone distinguishes that species from *P. abnormalis*.

From an examination of a series of about twenty individuals, I am inclined to think that the rarer *P. pulchellus* is merely a very abnormal variation of the common *P. abnormalis*, but for the present I leave this open, for there is a distinct gap in my series between the most swollen plates of *P. abnormalis* and those of *P. pulchellus*.

Mediaster sladeni, sp. nov.

Plate VII, figs. 1–5.

Station 29.

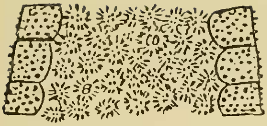
A single specimen, dried; pale buff-brown. The general outline is not unlike that of *A. miliaris*.

Measurements: R. 75, r. 35. r : R = 1 : 2·14.

The upper surface is formed of round-topped subcircular plates bearing numerous rounded tubercles, the plates being separated by papular areas. The large disc plates support a marginal series or circle of sixteen to eighteen more or less prismatic tubercles of unequal thickness, surrounding a circle of eight or ten similar but smaller ones, and, centrally, one, two, or three others, according to whether the plate itself is circular or oval in shape.

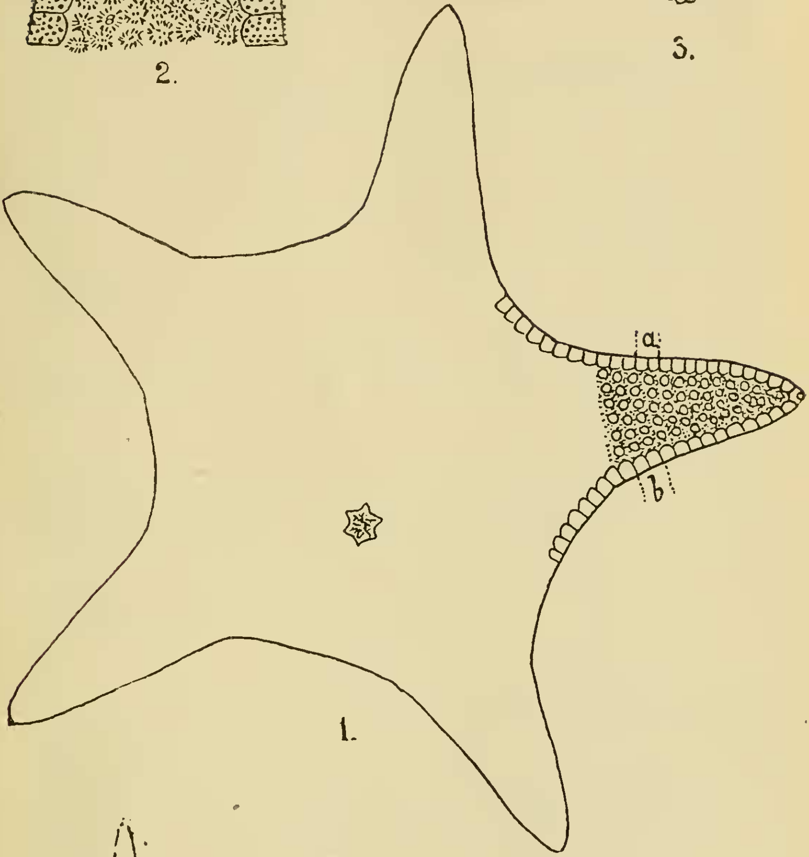
These plates are continued on to the rays, where they are rather smaller than on the disc; and as the tip is approached the tubercles become shorter, and the tabulæ more convex, so as to appear almost hemispherical.

Plate VII.

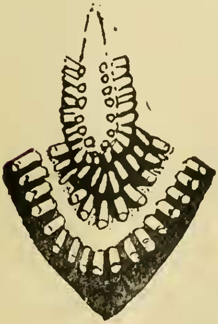


2.

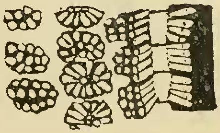
3.



1.



5.



4.

The supramarginals, of which there are 50 from the tip of one arm to the tip of the next (or twenty-five on each side of an arm), diminish in breadth as the apex is approached, but less markedly so than in *M. arcuatus* Sladen. The breadth now exceeds the length.

Valvate pedicellariæ are few, but in fair number irregularly scattered on the abactinal surface. The madreporite is rather large, about 2½ times the diameter of the neighbouring plates ; is six-rayed ; and lies near the centre of the disc, from which it is separated by its own diameter, whilst it is about six of its diameters from the margin.

The marginals are covered with low rounded tubercles, of which those on the edges of the plates are rather larger (not smaller as in *M. arcuatus*) than those on the face.

A few large valvate pedicellariæ occur on the supramarginals, varying in number on the five " sides " of the starfish (*i.e.*, between tip and tip of the two arms) : on two sides, none ; on the third side. 1 ; on the fourth side, 3 ; on the fifth side, 5. The inframarginals alternate with the supramarginals, except the odd interbrachial plate, and sometimes the one on each side of it. I see no pedicellariæ on these plates.

The adambulacrals carry 4 longitudinal rows of stout, prismatic, round-topped spines ; the innermost row, overhanging the groove, consists of 4 or 5 spines : if the former, one is much stouter than the other three. They stand closely side by side, looking like a thick-toothed comb, and have brown tips. The second row contains 3 or 4, the third only 3 spines. The 3 or 4 of the outermost row are, as usual, much smaller than the preceding, and only a little larger than those on the actinal plates. Sometimes this row is irregular, so that an imperfect fifth row is apparently present.

The angle of the mouth bears on the margin about 16 to 18 stout prismatic spines, similar to and of the same length as the innermost adambulacrals, directed towards the centre. On the actinal surface of each of the angle-pieces is a row of 6 or 7 similar but rather smaller spines, like those of the second row but slightly stouter ; and also a few small tubercles are present. The actinal plates are continued from the interbrachial areas along the arm to the level of the fifth or fourth marginal from the tip. All these plates are similar to those on the upper surface, and I see no pedicellariæ.

Locality.—Off Oamaru, on shell gravel, at a depth of 25–30 fathoms.

Remarks.—The leading difference between this starfish and *Asterodon miliaris*, to which it bears a considerable superficial resemblance, is in the character of the oral armature ; for, in place of the two reflexed dental spines at each oral angle, this species bears a number of small spines similar to those of the adambulacrals.

I have had access only to Sladen's description of *M. arcuatus*, of which a single individual was during the " Challenger " expedition obtained from the Japan Sea. From it mine differs chiefly in numerical proportions—(*a*) size, (*b*) number of adambulacral spines. (*c*) number of oral spines, (*d*) number of spines on the abactinal plates. (*e*) number of marginals, &c. Several other species have since been described, from the eastern shores of the Pacific, but I am unable to make any comparisons with them.

Asterina regularis, Verrill.

Farquhar. *loc. cit.*, 1898, p. 312, for synonymy.

Specimens were obtained at several stations. It is by far the commonest of the littoral starfishes on, at any rate, the South Island, and Mr. Farquhar has published some interesting notes on it [15].

Localities.—Coast of Otago [and generally round the South Island, and Wellington].

Stichaster polyplax Muller and Troschel.

Tarsaster neozealanicus Farquhar, 1895. Farquhar, *loc. cit.*, 1898 p. 313.

A single small specimen was collected, but was without indication of station when it reached me. It is fairly common on the shores of both Islands, having been recorded from Auckland, Wellington, Nelson, Sumner, Otago, as well as from the Chatham Islands.

Stichaster insignis Farquhar.

Farquhar, *loc. cit.*, p. 314, for synonymy.

Stations 24, 29.

Two bright-red starfishes, which I refer to this species, differ slightly from one another and from the account of the species given by Farquhar in 1895.

In the first place they are considerably larger. One of them, with six arms, has R. 88, r. 12 mm.: r. : R. = 1 : 6·33, with the greatest width of arm 18 mm., which is at a short distance from the base. I cannot detect any definite madreporite, though at two spots the abactinal plates are crowded.

The other, with five arms, one of which has evidently been regenerated, measures R. 71, r. 7 mm.; so that r. : R. = 1 : 10·14. This one shows the characteristic four madreporites, though the spines on the abactinal surface are less numerous than in typical specimens in this Museum. In the larger specimen the arrangement of plates and spines agrees with these individuals which I received from Mr. Farquhar.

The greater size of the specimens may be related to the greater depth at which they were obtained.

Localities.—Off the east coast of Otago, on sand, shell, and gravel, 18 to 38 fathoms.* [Taylor's Mistake; Wellington (F.).]

Echinaster farquhari, sp. nov.

Plate VIII, figs. 1–4.

Station 15.

A single specimen; in a dried state orange in colour when first received, but is now faded. It measures R. 55, r. 13 mm.—thus R. > 4 r.; breadth of arm, 17 mm. The five arms are blunt at the tips, which are upturned; the base of each is somewhat swollen, so that a well-marked interradial furrow traverses the disc for nearly half its radius.

The madreporite, which is situated about midway between the centre and margin, is circular, very prominent, projecting above the general surface; is coarsely furrowed, and not surrounded by spines.

The abactinal skeleton consists of an irregular network of short ossicles leaving larger and smaller meshes: the former are often partially occupied by small irregular ossicles, which nearly subdivide the mesh. On the disc the meshes are smaller, the main ossicles being closer together than on the arms. In the larger meshes on the latter some 6 or 8 papulæ occur; on the smaller, only a single papula.

On the abactinal surface of the disc spines are practically absent, and are few and widely scattered on the upper surface of the arm. Here and there an isolated, short, blunt, apparently immovable spine springs from a node in the network; they become relatively more numerous, but still few and widely spaced, as the tip of the arm is approached. At the sides of the arm, however, they are more definitely arranged, as also are the ossicles.

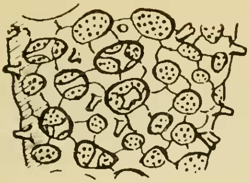
I see no pedicellariæ anywhere.

The ambulacral grooves are very narrow and deep, the podia being, of course, in two series; the groove is concealed by adambulacral spines, which are long enough to reach across it. Each adambulacral ossicle carries 4 stout, nearly cylindrical, blunt spines, arranged in a transverse row in regard to the groove. The innermost is rather shorter than the next, which is the stoutest and longest of

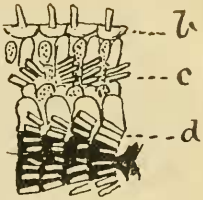
---

* During the examination of these specimens I endeavoured to trace the starfish which Hutton identified as *Uniophora granifera* (Trans. N.Z. Inst., xi (1878), 306), and which was at that time in the Otago Museum. I failed to find any that agrees with Muller and Troschel's description and figure, and I have come to the conclusion that Hutton must have been mistaken in his identification; perhaps he confused it with *Stichaster australis*, especially as the above authors, in a footnote (p. 20), state that *Uniophora* includes species which they had formerly placed in that genus. I communicated with Mr. Farquhar asking him whether he had ever met with the species; he replied that he had not, and that he had likewise come to the conclusion that the genus had been included in our list in error.

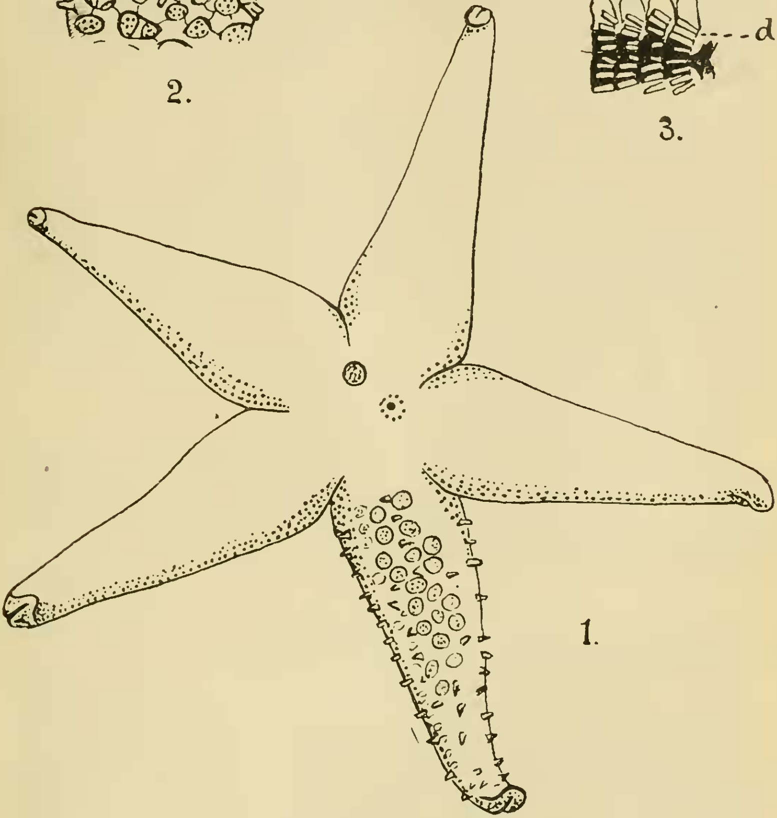
Plate VIII.



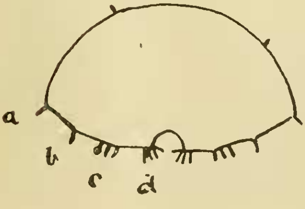
2.



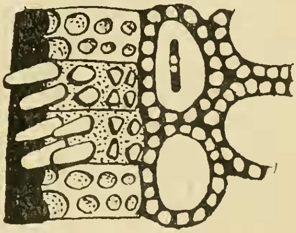
3.



1.



4.



5.

the four. This innermost springs from the edge of the plate and extends almost horizontally across the groove; the remainder project vertically and are divergent.

Outside the adambulacrals is a continuous series of small intermediate ossicles, each with a spine somewhat smaller than the adambulacrals: these intermediates are present for only about half-way along the arm. Outside these is a row of rather closely set, vertically elongated ossicles (figs. 3, 4, *c*), separated from one another by a papular space. These ossicles are connected at their upper ends by a series of horizontal, slightly keeled ossicles (*b*), which gives rise to a continuous slight ridge along the ventral margin of the arm, as seen from below. These vertical ossicles bear groups of spines, each group consisting of 2, 3, or 4 spines, shorter than the adambulacrals, disposed vertically above one another. Above these ossicles again there is another row of vertical ones, succeeded by a second ridge formed of horizontally arranged ossicles (*a*), which form the lower margin of the curved edge of the arms, as seen from above. (*Cf.* transverse section of arm, fig. 4.) This ridge bears pairs of spines of the same size as those of the lower ridge. Above the second ridge the irregular network of the abactinal surface commences—somewhat denser at the sides, looser above, with rare, isolated spines.

Locality.—Off Otago Heads, 18–38 fathoms.

Remarks.—This species is very different from *E. purpureus*, of which there is a specimen in this Museum. It is not unlike *E. eridanella* M. and T., from the Admiralty Islands and Thursday Island; but this seems to have constantly six arms and two madreporites, according to Perrier (Ann. Sci. Nat. Zool. (5), xii, p. 250).

Asterias calamaria Gray.

Farquhar, *loc. cit.*, 1898.

Stations 16, 20.

This, one of our commonest long-armed, many-rayed littoral starfishes, was obtained only at two stations off the east coast of Otago. Sladen (1889, p. 563), placed this and the following species in his sub-genus *Stolasterias*, characterized by the definitely arranged spinelets, large and isolated, surrounded by dense wreaths of pedicellariæ. But in 1867, Verrill [37] had described the species under the name of *Coscinasterias muricata*, which he did not then recognise as being Gray's *A. calamaria*. Verrill's generic or subgeneric name ought, then, to have precedence of Sladen's so far as this species is concerned (see Fisher, 1906, A.M.N. Hist. (7), xvii, p. 574). But I have preferred to leave both the species under the generic title of *Asterias*. Various other subgeneric names have been proposed by Perrier; but even Hamann [21] omits them in his lists.

Mr. Farquhar [14 and 16] has given a valuable and interesting account of certain bionomic facts relating to this species.

Asterias mollis Hutton.

Farquhar, *loc. cit.*, 1898, p. 316.

Stations 9, 16.

This species was obtained off the east coast of Otago. It does not appear to be so widely distributed as the preceding. Farquhar refers only to Lyttelton as its provenance, but it occurs, though not very abundantly, at Dunedin.

OPHIUROIDEA.

Ophiomyxa australis Muller and Troschel.

Farquhar, *loc. cit.*, 1898, p. 309.

This is a very common denizen of the rock-pools of the southern portion of New Zealand; indeed, it appears to be the commonest of our ophiurids. It has, too, a very wide distribution outside the limits of our area. (See also Farquhar [18].)

Astrotoma waitei, sp. nov.

Plate IX, figs. 1–6.

Stations 15, 16, 22.

Astrotoma is one of the few genera in which the arms can be rolled inwards towards the mouth; and these arms are unbranched.

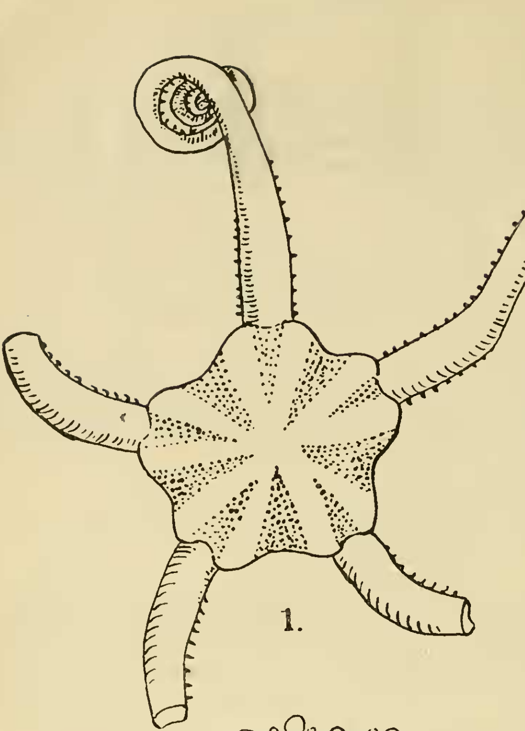
This is the first recorded occurrence of the genus in New Zealand waters. Three specimens were received by me; when dried they are a dirty white in colour.

The diameter of the disc is 33 mm.; the height in the centre is 20 mm.; the length of the arm is ± 130 mm.; the width of the arm at base is 9 mm.; height of the arm is 7 mm. As the tips of the arms were more or less coiled, it is difficult to determine accurately their lengths; but the above is an approximation.

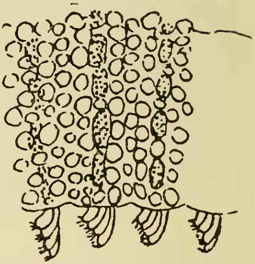
The upper surface of the disc is covered by closely set, rounded scales of two chief sizes, though others of intermediate size occur; the smaller ones filling the gaps between the larger, which are about 1 mm. in diameter. They have no definite arrangement. In the interbrachial spaces the small ones decrease in size as the margin is approached, and here the larger ones become fewer, so that the intergenital areas are finely granulated, the granules being rather more inclined to be spinous than elsewhere. The adradial plates, which are about 5 mm. broad near the edge of the disc, and are covered by the scales, form marked ridges extending to the centre of the disc, which is, in the dried specimens at any rate, slightly raised above the general surface.

The actinal or oral surface is tesselated with closely set, flattened, and nearly uniform granules, smaller than those on the lower surface of the arms.

Plate IX.

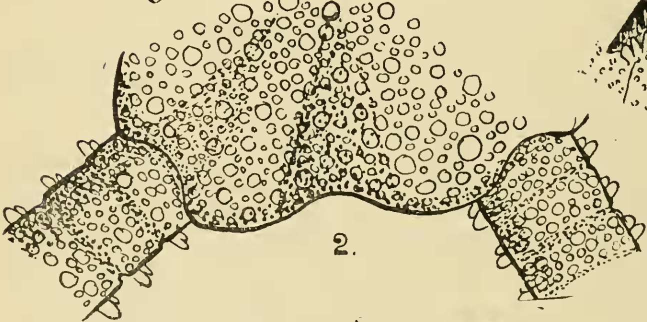


1.

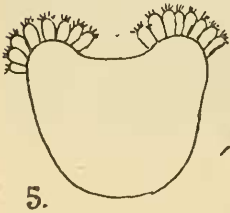


4.

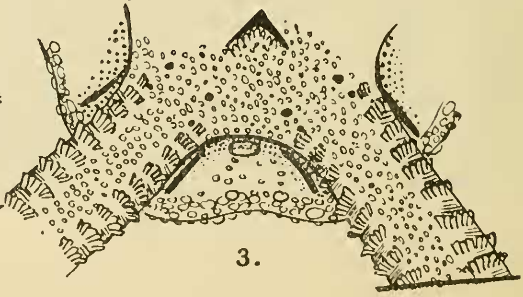
6.



2.



5.



3.

The mouth-angles are covered with even smaller scales; each carries near its apex several long conical spines, which are not confined to the apex, but extend along the sides of the mouth-angles, and also within the buccal cavity, in two or three tiers, so as to appear almost like buccal or oral papillæ. They are more numerous and more slender than the tooth papillæ of *Astrotoma agassizii* Lyman.

A small oval madreporite lies at the edge of the horizontal circumoral region, just below the ridge or fold connecting two neighbouring arms, and which separates the intergenital area from the oral area. It measures 1·5 mm. in length which is horizontal or tangential, and 1 mm. in length which is vertical or radial. The genital clefts are 4 mm. in length—two in each interbrachial space.

The arms are high, strongly arched abactinally and flattened below, tapering gradually; and the ends are coiled, to a greater or less degree, in all the specimens. The sides and upper surface are covered with granulated scales, and in the dried specimens the skin is depressed between the vertebral ossicles, so that the arm appears segmented—that is, it is surrounded by narrow grooves alternating with broader raised areas: in the grooves the scales are not perceptibly smaller than elsewhere. On each side of the arm, on each of the raised areas, there are about twelve groups of minute glassy hooklets, forming an interrupted ring round the lateral and upper surfaces of the arm; each group is borne on a flattish plate, a little sunken, surrounded by a more or less evident circle of the larger granules of the skin.

The under-surface of the arm is covered by uniform rounded granules, rather larger than those on the under-surface of the disc, but smaller than those on the sides of the arm. Each " segment " of the arm carries 8–10 short, cylindrical, blunt spines, terminating in a tuft of glassy spicules, so that the tips are distinctly rough. At about three-quarters of the length of the arm they begin to decrease in number, till only 1 or 2 long, slender, clawlike spines remain: this reduction is effected by the disappearance of the spines outside or above the pore.

It is clear that these claws, as well as the roughened tips of the spine, serve admirably for grasping objects round which the arms may be coiled; and it happens that in most of the specimens these hooks have been broken away on removing the animals from the net in which they were captured. These " arm spines " or " tentacle spines " are set on a granulated ridge.

The tentacle pore is on a level with the third spine from below, so that there are from 5–7 spines above, or outside, the pore. The first tentacle pore, situated on the disc, is without a spine: the second, which is on the base of the arm, just where it joins the disc, is provided with 3 or 4 spines: the third pore has 5 spines on a ridge: the next, 6 or 7, and the full number is soon attained.

Locality.—East coast of Otago.

Remarks.—Only four species of *Astrotoma* have hitherto been described: *A. murrayi* Lyman, 1882, obtained by the "Challenger" at Banda Islands, 200 fathoms; *A. agassizii* Lyman, 1875, from the Straits of Magellan, 135 fathoms: from both of which our species differs in various respects. The descriptions of *A. bellator* Koehler, and *A. vecors* Koehler, got during the "Siboga" expedition (1904) from the Sulu Archipelago and Banda Sea respectively, are not accessible to me, so it may turn out that ours is synonymous with one of them.

Amphiura noræ, sp. nov.

Plate X, figs. 1–3.

Station 83.

The colour of the solitary specimen is, in alcohol, and later when dried, pale greenish-grey, with whitish arms. The disc, which is 9 mm. in diameter, is deeply notched interbrachially. The arms are more than 45 mm. in length (the tips are broken); each is about 1·5 mm. across the base. The upper surface is covered with small, flat, round, overlapping scales; a central and 5 radially situated scales, a little distance from the centre, are circular and distinctly larger than the rest. The scales decrease in size towards the margin, though those immediately bordering the adradial plates are rather larger than their neighbours.

The adradials are narrow, convex externally, slightly concave internally, extend about half-way towards the centre of the disc, and do not quite reach the margin. They measure 2 mm. in breadth by 5 mm. in length. The two adradials of a pair are separated by a row of 3 long plates, and their proximal ends by 2 or 3 rounded ones.

The mouth-shields are somewhat oval, with the slightly longer axis radial. The proximal margin is slightly peaked; the distal convex, with two very slight notches dividing the margin into three nearly equal portions, of which the middle is rather more pronounced.

The side mouth-plates are broader distally than orally where they touch; the lateral margin is slightly excavated.

There are 3 buccal papillæ on each side of each mouth-angle—one at the apex of each jawpiece forming the angle, a second smaller one laterally, while the third is very large, oval, and plate-like, nearly as long as the side mouth-plate, and resembling a "tentacle scale."

The actinal interbrachial area is almost naked; there is at the margin a very narrow band of small scales, continuous with those of the upper surface of the disc, another narrow band along the side of each genital cleft, and a few small, isolated scales in the intergenital area. This naked interbrachial area, and the presence of the middle of the three buccal papillæ, serve to distinguish this species from *A. rosea* Farquhar [13], to which it bears, otherwise, a general resemblance.

The upper arm-plates are transversely oval, with a slight peak in the middle of the distal border; between them the side arm-plates are visible reaching nearly to the middle line. The under arm-plates are approximately square, nearly as broad as they are long, with the lateral and distal margins slightly excavated, and the proximal slightly produced and angulated. The side arm-plates support four comparatively long, slender, pointed, conical arm-spines, the second of which is longest, and the uppermost the shortest. Further along the arm the upper one disappears.

Locality.—Off Cape Kidnappers, east coast of the North Island.

Remarks.—This species seems to be near *A. koreæ* Duncan [12], in which, however, the intergenital area is plated.

Ophionereis schayeri Muller and Troschel.

Farquhar, *loc. cit.*, 1898, p. 307.

A few specimens of this very common littoral species were included. It appears to be distributed all along our coast. (See remarks by Farquhar [18].)

Ophiactis nomentis Farquhar.

Ophiactis nomentis Farquhar, Trans. N.Z. Inst., xxxix, 1906, p. 125.

Unfortunately the station-number of this species is not recorded. It was obtained by Farquhar in 4 fathoms of water at Cape Maria van Diemen, but our specimens must have been got south of this, and on a sandy bottom, for sand still adheres to them. Their colour is now grey, mottled with white, especially on lateral portions of the upper arm-plates.

Pectinura maculata Verrill.

Farquhar, *loc. cit.*, 1898, p. 306, gives synonymy. Koehler, Bull. Sci. de la France, xli, 1907, p. 285, pl. x, fig. 34.

Stations 6, 9, 15, 24.

This handsome and not uncommon species, described so long ago as 1869, has only recently been figured by Koehler.

Localities.—Stewart Island, south and east coast of South Island. [D'Urville Island, in Cook Strait; Wellington; Auckland; Chatham Islands (Farquhar).]

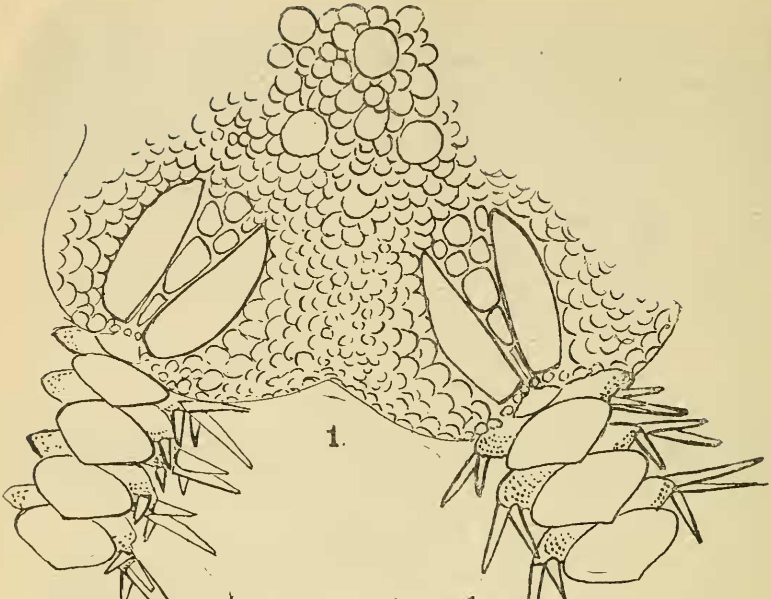
ECHINOIDEA.

Goniocidaris umbraculum Hutton.

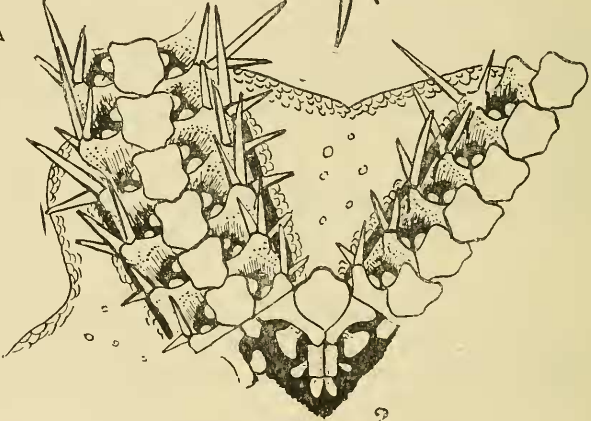
Farquhar, *loc. cit.*, 1898, p. 316.

Several examples of this curious little cidaris were obtained. The characteristic spines, dilated at the tip to form a flattened or concave terminal disc, are unmistakable. Hitherto it has only been obtained from the shores of Stewart Island, and doubtless these present specimens came from that neighbourhood.

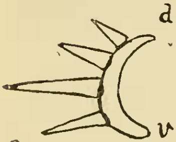
PLATE X.



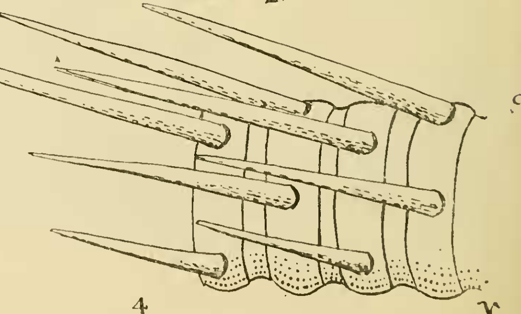
1.



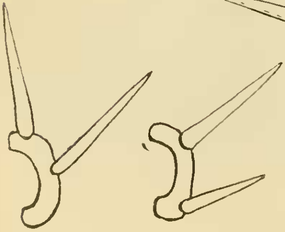
2.



3.



4.



5.

Porocidaris elegans Agassiz.

Porocidaris elegans Agissiz, Proc. Amer. Acad., xiv, 1879, p. 198; "Challenger" Reports, iii, 1881, p. 40.

Histocidaris elegans Mortensen, Danish Ingolf Exped. 1903, pp. 21, 30.

Stations 83, 89.

This little cidarid has hitherto been obtained off Sydney and the Philippines, and its discovery in considerable numbers off New Zealand has much interest.

The only difference that I can detect, from the abbreviated account in the "Challenger" report (for I have not access to the earlier description), is the fact that there is in our specimens no crenulation on the boss of the tubercles. Wyville Thomson [36] pointed out, and Agassiz gives further evidence, that cases are known in which some individuals of a species usually having crenulated tubercles have smooth bosses. Also, both in *P. purpurata* Thomson and *P. elegans*, only some of the tubercles exhibit this feature. As our specimens are all smaller than those obtained by the "Challenger," their absence may be due to immaturity. In all other respects, however, the agreement is so close that I do not feel justified in making a new species.

This little cidarid is readily distinguished from our other member of the family, not only by the greater length and delicacy of the spines, the length of which is 2 to 3 times the diameter of the corona, but by the peculiar flattened pectinate spines around the mouth. Our specimens are smaller than those described by Agassiz. Height, 10 mm.; diameter, 19 mm.; plates, 6 in a vertical row.

I have followed Agassiz in rejecting Mortensen's generic name.

Localities.—Cape Kidnappers, 76–82 fathoms, soft mud; Cape Runaway, 105 fathoms, sand and mud: both on the east coast of the North Island.

Echinus angulosus Leske.

Farquhar, *loc. cit.*, 1898, p. 319.

Parechinus angulosus Mortensen, *loc. cit.*, 1903, p. 108.

Plate XI, fig. 5.

Station 29.

There are two specimens of an echinid which I attribute, with some hesitation, to this species, for the following reasons: (*a.*) The species is already recorded from New Zealand by Agassiz (1872, p. 490). (*b.*) There are several examples from Stewart Island in this Museum, so labelled by Captain Hutton. (*c.*) There is a fairly close resemblance between them and the photograph of *Echinus angulosus* given in Agassiz's "Revision," pl. vii *a*.

At the same time I feel doubtful as to the correctness of this identification, for—(1.) A detailed comparison with Agassiz's account of the arrangement of the tubercles in *E. angulosus* shows several differences;

indeed, the figure recalls that of *E. albocinctus*, but the colour of the test is quite different. (2.) The measurements do not yield the same proportions as those given by Agassiz, in which the number of interambulacral tubercles in a vertical row is less for a given height, and the spines are rather larger for a given diameter, than in our specimens. (3.) Filhol (1885) states, on the authority of Perrier, that the common *Echinus* which he collected on Stewart Island and in Cook Strait is *E. margaritaceus*, and makes no mention of *E. angulosus*.

Unfortunately I have not access to any detailed account of the former, but Agassiz refers (p. 493) to the large pedicellariæ and large miliaries as being characteristic; he also states that the primary spines are white and the secondaries yellow; while the photographs given by Agassiz and Pourtates (1874) show a very different type of tuberculation. Hence I conclude that our specimens are not *E. margaritaceus*. Moreover, Koehler's *E. antarcticus* (1901)—which Mortensen has suggested may be a synonym of *E. margaritaceus*—has a distinct centro-dorsal surrounded by quite small periproct plates; the coronal plates are few and high; and the general appearance and details are different. As Mortensen made the above suggestion (although disallowed by Loriol), there must be similarities between the two species, and, if so, it is evident that our urchin is not *E. margaritaceus*. At the same time it is curious that this species, which Filhol found so common, is not represented in any of our museums here.

In view of this doubt, and as no description of our *E. angulosus* has appeared in publications readily accessible to naturalists in New Zealand, I give the following brief account.

Measurements were taken of our largest and smallest denuded individuals.

	A, 25 interambulacral tubercles. Mm.	B, 18 tubercles. Mm.
Diameter	42	30
Height	27	18
Width of abactinal area	7	6
,, actinal area	13·5	11
,, poriferous zone	3·3	2
Spines (longest)	6–8	5-7

The poriferous zone was measured at the ambitus. The largest tubercles are below the ambitus.

The colour of the (dried) test is a light greenish-grey with pale-brown poriferous zone, and a line of the same tint in the middle of each ambulacrum; the spines are pale-green, tipped with white; those around the mouth in recently obtained specimens are very pale violet below the tips; the secondary spines are olive brown.

In the interambulacral area each plate bears a moderately large tubercle, outside which are two smaller tubercles in a horizontal row; or in plates near the ambitus two rows of such tubercles, and on the inner side a single tubercle of about the same size. The arrangement reminds one of that occurring in *E. albocinctus.* The miliaries are not very numerous, and are somewhat large.

In the ambulacral area each plate bears a single tubercle only a little smaller than those of the main vertical row in the interambulacrum, and throughout the greater part of the area there is a smaller tubercle on the inner side ; those in the poriferous zone are quite small.

Poriferous zone narrow ; pores trigeminate, in short curved rows, wider than in *E. albocinctus.*

In the apical ring none, or only one, of the oculars in our specimens reach the periproct, the external plates of which are rather large, centrals small. The genital plates bear 3 or 4 tubercles in a row near the inner margin, which are not much smaller than small ones in the neighbouring interambulacra.

The peristomial area is naked, except for small buccal plates close to the mouth.

Locality.—Off Oamaru, 25–35 fathoms. [Stewart Island, Dunedin (O.U.M.) ; Cape Campbell, Kaikoura (Farquhar).]

Echinus albocinctus Hutton.

Echinus albocinctus Hutton, 1872, Cat. Ech. N.Z., p. 12.

Echinus magellanicus Hutton, 1876, non Philippi ; Farquhar, *loc. cit.*, 1898, p. 320.

Pseudechinus albocinctus Mortensen, 1903, p. 106.

Echinus albocinctus Loriol, 1904, p. 18, pl. i.

Pseudechinus albocinctus Benham, Ann. Mag. Nat. Hist. (8), i, 1908, p. 107.

Stations 22, 24.

Eight specimens of this brightly coloured urchin were obtained off Shag Point and Moeraki, at depths of 20–40 fathoms, in a bottom of fine sand. [Also Stewart Island (O.U.M.).]

In the present article I have refrained from using Mortensen's generic names, for I gather from an abstract from Agassiz's introduction to his account of Panamic Deep-sea Echini (kindly made for me by Mr. Farquhar) that he is unable to accept them, owing to the insufficient basis on which they are founded, and that other echinologists also hesitate to use them.

Echinus huttoni Benham.

Salmacis globator Hutton, 1878, non Agassiz.

Pseudechinus huttoni Benham, Ann. Mag. Nat. Hist. (8), i, 1908, p. 104.

Stations 15, 16, 22, 24.

Five individuals of this species, which has for so long been known but has been concealed under an erroneous pseudonym, were obtained off Otago Heads, Shag Point, and Moeraki, at depths of 18–44 fathoms, on a bottom of fine sand. [Also Stewart Island, Preservation Inlet (O.U.M.).]

Arachnoides placenta Linnæus.

Farquhar, *loc. cit.*, 1898, p. 321.

This "cake-urchin," or, rather, "biscuit-urchin," is common on sandy beaches. Only one specimen was received, without indications of locality; but, as it is widely distributed, this omission is immaterial.

Echinocardium australe Gray.

Farquhar, *loc. cit.*, 1898, p. 322.

Station 30.

Only three individuals were preserved; they are quite immature. Probably, living as they do imbedded in the sand, the trawl missed many other specimens, for they must be fairly abundant.

Localities.—Off Oamaru. [It is very common round the South Island. It would be interesting to ascertain how far north it occurs.]

HOLOTHUROIDEA.

Phyllophorus longidentis Hutton.

Thyone longidentis Hutton, Cat. Ech. N.Z., 1872, p. 16.

Phyllophorus longidentis, Dendy and Hindle, Journ. Linn. Soc. (Zool.), xxx, 1907, p. 101, gives literature and synonyms.

Station 95.

One complete small individual and many, more or less digested, specimens were obtained from the stomach of the fish *Pagrosomus*. This suggests the desirability of examining the contents of various species of ground-feeding fishes for these and other mud-loving animals.

Locality.—Off Whale Island, Bay of Plenty, 25–34 fathoms, sand and mud.

Caudina chilensis J. Muller.

Caudina coriacea Hutton, 1872; Dendy and Hindle, *loc. cit.*, 1907, p. 108.

Caudina chilensis, Clark, Smithsonian Contributions, xxx, 1907, p. 175 (full synonymy).

Station 7.

A single specimen.

Locality.—South of Chasland's, 43 fathoms, fine sand.

Dr. Lyman Clark, in "Apodous Holothurians," 1907, p. 175, states that the specific name "*chilensis*" has priority over "*coriacea*." The species also occurs off Chili, Australia, East Indies, China, and Japan.

Molpadia marenzelleri Théel.

Ankyroderma marenzelleri Théel, "Challenger" Reports, xiv, 1886, p. 41, pl. iii, fig. 1.

Molpadia marenzelleri, Clark, Smithsonian Contributions, xxx, 1907, p. 171, pl. xi, fig. 4.

Station 83 (?)

Only one specimen of this rare deep-sea species was received by me.

The ovoid body is speckled with pale-red dots, due to the coloured phosphatic bodies in the skin; the body towards the posterior end is abruptly narrowed and prolonged backwards as a white tail.

The total length is 28 mm., of which the tail occupies 7 mm.; the greatest breadth of the body is 18 mm.

The only essential difference between this and Théel's type specimen, which was imperfect, and was captured off the East Cape at a depth of 700 fathoms, appears to be that the majority of the calcareous plates (or "tables") present only 3 or 4 perforations instead of 6.

Locality.—Cape Kidnappers, 68–78 fathoms, soft mud.*

Clark (see pp. 17–21) goes fully into the reasons for merging both *Ankyroderma* and *Trochostoma* in Cuvier's genus *Molpadia*. On page 143 the chemical analysis of the curious coloured bodies in the skin is given: they consist chiefly of phosphate of iron, with a little lime, and perhaps magnesium.

Molpadia dendyi sp. nov.

Plate XI, figs. 1–3.

A single specimen; colour, deep maroon-red with a purplish tinge. Length, 65 mm., of which the white tail measures 15 mm.; diameter of body, which is rather shrunken, is 20 mm.; the tail is 2 mm. across. The oral region, which was not retracted, measures 4·5 mm. The tentacles, of which there are, I think, 15, are withdrawn, and, as far as I can make out, are short and rounded, and possess only one pair of minute processes near the tip.

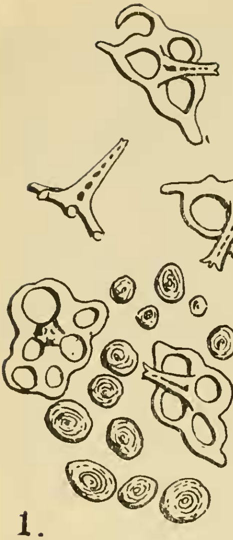
The purplish skin, which is a good deal wrinkled, and covered with a fine grey mud in the folds, is seen when viewed under a dissecting-lens to be dotted with more or less distant pale spots where the vertical spines of the calcareous "tables" project through the layer of coloured ovoid concretions. On one surface of the body, which is the more convex, these spines project further beyond the surface.

The deposits in the integument are of two kinds—(*a*) orange-brown concentrically-marked ovoid or spherical phosphatic bodies, and (*b*) calcareous "tables" of the usual form. Over the greater part of the body the former constitute the chief feature, being densely massed, the tables being more or less isolated. On the tail, however, matters are reversed: the calcareous perforated plates are larger

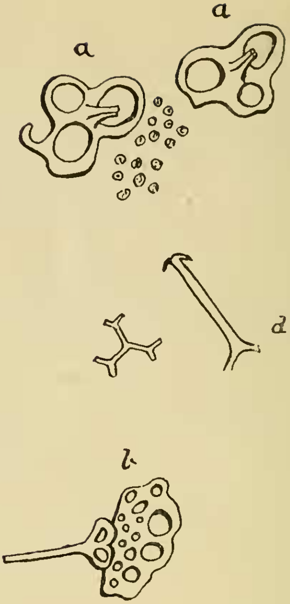
---

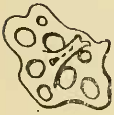
* This probably came from Station 83, though both this number and "30" were on labels in the jar; but, as this species has never been obtained off Oamaru (Station 30) in the various dredgings, whereas it, like all its allies, does occur in deep water, and a deeper sounding was at Station 83, I have placed it as above

Plate XI.

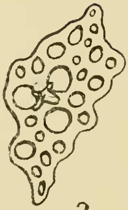


1.

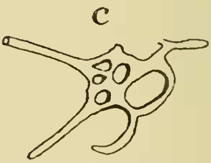




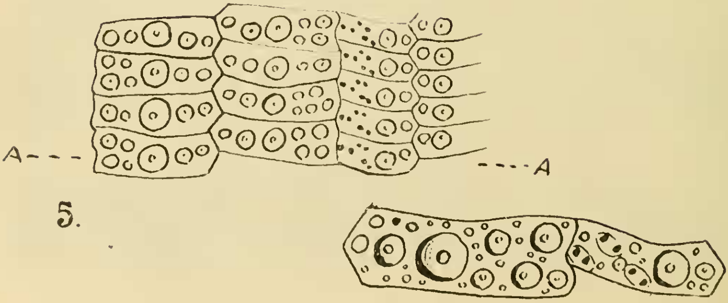
2



3



4



5.

than elsewhere ; are close together, often overlapping ; are less regular and more varied in form ; while the brown bodies are fewer, and grouped to form large irregular compact masses.

The plates on the body have generally 3 or 4 large circular holes, occasionally 2 or 3 additional smaller ones ; and from the centre rises a vertical column composed apparently of three rods united by several short transverse bars : it terminates in a trifid point.

These plates measure about 0·2 mm. across ; the spines are 0·1 mm. high. On the tail the number and size of the perforations in the plates vary much, but are usually much more numerous than in the body-plates.

Locality.—(?)South of Chasland's (South Island), 43 fathoms, fine sand.*

Remarks.—Two species of "*Trochostoma*" (which Lyman Clark merges into *Molpadia*) have been dredged off the East Cape of New Zealand by the "Challenger" : from each of them our present species differs. *T. violaceum* has spicules of quite a different form—great three-armed plates that are almost solid. From *T. albicans* the presence of coloured ovoids sufficiently distinguishes it. The plates in our species rather recall those of *T. antarcticum* from Kerguelen, which, however, has no coloured bodies in the skin.

I am unable to identify it with any of the species of *Molpadia* enumerated by Dr. Lyman Clark, 1907.

Chirodota gigas Dendy.

Chirodota gigas, Dendy and Hindle, Journ. Linn. Soc. (Zool.), xxx, 1907, p. 110.

Station 12.

Several badly preserved specimens, whose very dark violet integument was nearly wholly macerated away, fragments only being left here and there with the groups of characteristic wheels.

The longest individual measures 230 mm. by 12 mm. This is more than twice the length of the type of the species obtained from Chatham Islands.

Dendy says nothing of the colour of his specimen, and possibly my identification is erroneous.

Locality.—Molyneux Bay, 20–46 fathoms, sand.

[I have others, collected many years ago by Mr. G. M. Thomson off Stewart Island. These measure from 130 mm. to 170 mm. by 39 mm. across the widest part of the body, which is the anterior end. They are, however, very soft, so that the above figures exaggerate the true size.]

---

* The vial in which this and *Caudina* were enclosed bore the number "7," but I am inclined to think that this species came from deeper water off the coast of the North Island.

BIBLIOGRAPHY.

1. Agassiz, 1872. Revision of the Echini. (Illust. Cat. Mus. Comp. Zool., vii.)
2. Agassiz, 1881. "Challenger" Reports, iii, Echinoidea, p. 40.
3. Agassiz 1906. Mem. Mus. Comp. Zool., xxxi.
4. Agassiz and Pourtales, 1872. Zool. Results of the Hassler Exped. (Illust. Cat. Mus. Comp. Zool., viii.)
5. Bell, 1881. Echinodermata of H.M.S. "Alert." Proc. Zool. Soc. p. 87.
6. Bell, 1893. Proc. Zool. Soc., p. 259.
7. Benham, 1908. Ann. Mag. Nat. Hist. (8), i, p. 104.
8. Clark, Lyman, 1907. Smithsonian Contributions to Knowledge, xxxv.
9. Delage and Herouard, 1903. Zoologie Concrete : Echinodermes.
10. Dendy, 1896. Journ. Linn. Soc. (Zool.). xxvi, p. 22.
11. Dendy and Hindle, 1907. Journ. Linn. Soc. (Zool.), xxx, p. 95.
12. Duncan, F. M., 1879. Journ. Linn. Soc. (Zool.), xiv, p. 466.
13. Farquhar, 1894. Trans. N.Z. Inst., xxvi, p. 110.
14. Farquhar, 1895. Trans. N.Z. Inst., xxvii, p. 194.
15. Farquhar, 1897. Journ. Linn. Soc. (Zool.), xxvi, p. 186.
16. Farquhar, 1898. Trans. N.Z. Inst., xxx, p. 187.
17. Farquhar, 1898. Proc. Linn. Soc. N.S.W., p. 300.
18. Farquhar, 1906. Trans. N.Z. Inst., xxxix, p. 123.
19. Filhol, 1885. Mission à l'Isle Campbell, p. 572.
20. Gray, J. E., 1867. Synopsis of the Species of Starfish in the British Museum.
21. Hamann, 1899. Bronn's Thier-reichs : Echinodermata (Asteroidea).
22. Hamann, 1903–4. Bronn's Thier-reichs : Echinoidea.
23. Hutton, 1872. Catalogue of N.Z. Echinoderms.
24. Koehler, 1901. Resultats du Voyage du "Belgica."
25. Koehler, 1904. Ophiures de l'Exped. du "Siboga."
26. Koehler, 1907. Bull. Sci. de la France, xli, p. 285, pl. x, figs. 3 and 4.
27. Loriol, 1901. Notes pour servir à l'Étude des Echinodermes, ix, p. 43.
28. Loriol, 1904. Notes pour servir à l'Étude des Echinodermes (2nd series), ii, p. 16.
29. Ludwig, 1905. Zeit. fur Wiss. Zool., lxxxii, p. 37.
30. Lyman, 1875. Zool. Results of the Hassler Exped. (Illust. Cat. Mus. Comp. Zool., viii) : Ophiurids, p. 24, pl. iv, figs. 52–56.

31. Lyman, 1882. "Challenger" Reports, v, Ophiuroidea, p. 272, pl. xxii, figs. 5–7.
32. Mortensen, 1903. Danish "Ingolf" Expedition.
33. Muller and Troschel, 1842. System der Asteriden.
34. Perrier, 1894. Exped. du "Travailleur" et du "Talisman": Echinoidea, p. 244.
35. Sladen, 1889. "Challenger" Reports, xxx, Asteroidea.
36. Thomson, 1874. Phil. Trans., p. 726.
37. Verrill, 1867. Trans. Connecticut Acad. (reprinted in Trans. N.Z. Inst., xii, 1879, p. 278).

EXPLANATION OF PLATES.

PLATE VII.

Mediaster sladeni Benham.

Fig. 1. Outline of entire animal (× ½). Only a portion of an arm is filled in.

Fig. 2. Upper surface of a portion of the arm (× 2).

Fig. 3. One of the paxilliform plates (× 4).

Fig. 4. Under-surface of a portion of an arm (× 2), showing the adambulacrals of one side of the groove, and the neighbouring ossicles.

Fig. 5. An oral angle (× 4).

PLATE VIII.

Echinaster farquhari Benham.

Fig. 1. Entire animal (natural size); details shown only in part of the arm.

Fig. 2. A portion of the upper surface of an arm about midway along its length (× 2).

Fig. 3. Under-surface of the distal region of an arm (× 2). A little more than half of the diameter is shown; unfortunately, the relative sizes of the adambulacral spines are not accurately drawn. *b*, *c*, *d*, rows of spines. (*Cf.* fig. 4.)

Fig. 4. Outline of a transverse section of an arm, showing the disposition of the spines on the longitudinal ridges. *a*, *b*, *c*, *d*, the four rows of spines along the arm.

Pentagonaster abnormalis Gray.

Fig. 5. The adambulacral ossicles and neighbouring region (× 4). The spines have been removed from two of the ossicles, the articular cups being shown. A pedicellaria is carried in the slit-like furrow of one of the abactinal plates.

PLATE IX.

Astrotoma waitei Benham.

Fig. 1. Entire animal (natural size), with three arms cut short.

Fig. 2. Portion of the upper surface (× 2).

Fig. 3. Portion of the lower surface (× 2), showing the small madreporite in this interradius.

Fig. 4. Lateral view of a portion of an arm (× 4), showing the groups of hooklets.

Fig. 5. Transverse section of an arm (× 4), showing the arm-spines and their spicules.

Fig. 6. A mouth-angle (× 4), showing the arrangement of the "papillæ."

PLATE X.

Amphiura noræ Benham.

Fig. 1. Portion of the upper surface (× 12, camera), showing the essential characters of the species.

Fig. 2. Portion of the under-surface (× 12, camera).

Fig. 3. A side arm-plate, with spines (not to scale).

Luidia sp.

Fig. 4. Portion of a side of an arm, showing the characteristic alternate arrangement of the spines. *d*, the upper, *v*, the lower, surface.

Fig. 5. Two successive marginal plates with spines.

PLATE XI.

Molpadia dendyi Benham.

Fig. 1. A group of plates and phosphatic spherules from the middle of the body, only a few of which are indicated, though they fill the spaces between the plates (× 60, camera).

Fig. 2. A calcareous plate from the tail region (× 60, camera).

Fig. 3. Another plate from the tail (not to scale), showing numerous small perforations in addition to three larger holes.

Molpadia marenzelleri Théel.

Fig. 4. Spicules (× 60, camera). A portion of an "anchor" is shown at *d*, and the base of another at *b*. The small circles represent the size of the phosphatic spherules. At *c* is one of the sub-anchor plates with radiating processes. A young plate is also shown.

Echinus angulosus Leske.

Fig. 5. A portion of the test (× 1), showing ambulacral and interambulacral areas. *A* is the ambitus; below is one plate for each area (× 2)